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Evaluation of Biochemical Parameters for Sickle Cell Anemic Children at Kassala City, Eastern Sudan

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Abstract:

Background: Sickle cell disease (SCD) is an inherited disease caused by gene mutation. Many investigators reported that Eastern Sudan has rich SCD and also an association with biochemical parameters such as liver and renal function tests.

Objective: The present study was to assess the plasma biochemical parameters such as urea, creatinine and sodium (Na) and potassium (K) total protein, albumin, Bilirubin, Aspartate Transaminase (AST), Alanine Transaminase (ALT) and Alkaline Phosphatase (ALP) in SCD as case group and apparently healthy persons as control group.

Materials and Methods: The study was conducted at Kassala Teaching Hospital, Kassala city, Eastern Sudan. This study was carried during December 2019 to January 2020. A total of 100 subjects enrolled in this study, 50 patients with SCD as case group and 50 apparently healthy as control group. The plasma biochemical parameters were estimated using Biosystem-350(Semi automated chemistry analyzer), and plasma Na and K were estimated using Easylyte. The data was analyzed using SPSS version (23).

Results: Study populations were matched age and sex, the age ranged from 5 to 15 years with their average age 8years. The plasma Na was insignificance difference in case compared to control group. The plasma K, urea and creatinine (p=0.039) were significantly increase compared to control group. Also the plasma total protein, albumin, Bilirubin, creatinine, AST, ALT and ALP were significantly increase in case group compared to control group. The age was strong association into plasma urea(r=0.583, p=.000) and plasma crearinine (r=0.759, p=.000). The negative correlation between plasma Na and plasma urea (r= -.335, p=0.017). There was positive correlation between plasma urea and creatinine (r=0.332, p=0.018). Their strong association between plasma Bilirubin and ALP activity (r= .563, P=.000), and also their strongly association between liver enzymes plasma level among SCD patients (r=.873, *381***,** 563, P= .000, .006, 000).

Conclusion: The study concluded that, significance increased in plasma K, urea creatinine, plasma total protein, and albumin, Bilirubin, AST, ALT and ALP. Strong association between age and plasma urea, creatinine, and the negative correlation between plasma Na

and plasma urea and also positive correlation between plasma urea and creatinine. There were positive correlation between plasma urea and creatinine. Their strong association between plasma bilirubin and ALP levels and also their strongly association between liver enzymes levels among SCD patients. Observation of the study concludes the biochemical abnormality play a significant role in sickle cell patient's physiopathology and can be used to management of the disease.

Key words: Sickle cell anemia, biochemical parameters, children's**,** Eastern Sudan

Introduction:

Various studies reported biochemical investigations of SCD are now well recorded [1,2]. SCD is a common genetic disorder which is the result of a single base-pair change thymine for adenine, at the sixth codon of the beta globin gene [3]. According to WHO statement in 2011, 300,000 children are born with hemoglobin disorders worldwide-annually that around 200,000 of them have sickle cell anemia that occur in Africa. Sickle cell disease is prevalent in many parts of India, where the prevalence has ranged from 9.4 to 22.2% in endemic areas [4]. Three quarters of sickle-cell cases occur in Africa. A recent WHO report estimated that around 2% of newborns in Nigeria were affected by sickle cell disease, giving a total of 150,000 affected children born every year in Nigeria alone. The carrier frequency ranges between 10% and 40% across equatorial Africa, decreasing to 1–2% on the North African coast and <1% in South Africa. It is characterized by chronic hemolytic anemia and vaso-occlusive crises, which can lead to widespread vascular occlusion by sickled red blood cells leading to multiple organ infarctions. In this respect, SCD can be considered as a multisystem disease for example: painful crisis, acute chest syndrome, fever and bacteremia, priapism, Stroke, splenic sequestration [5]. The sickle cell anemia can be diagnosed by clinical manifestation, PBS and hemoglobin electrophoresis. The most commonly used procedures for newborn diagnosis include thin layer/ isoelectric focusing and high-performance liquidchromatography (HPLC) [3]. Although the prevalence of liver abnormalities in SCD population is relatively low, the complications of hepatic dysfunctions are prominent and fatal in most of the cases [6]. Increased of plasma liver enzymes correlates with the different categories; haemolysis raises plasma AST while plasma ALT levels more accurately reflects liver injury [7]. High levels of plasma ALP are commonly seen in patients with sickle cell anemia this may be because of either cholestasis or bone disease [8]. Progressive decline in renal function is a common occurrence among children with SCD. This starts during infancy marked by reduced urine concentrating ability, glomerular hyper filtration and moderately increased albuminuria culminating to severely increased albuminuria, Chronic Kidney Disease (CKD) and End Stage Renal Disease (ESRD) among adolescents and young adults[9]. Progressive renal dysfunction is an important attribute to the reduced life expectancy in SCD patients and is reported to contribute 16–18% of the overall mortality in this population [10]. The present study aimed to assess the plasma biochemical parameters such as urea, creatinine and sodium (Na) and potassium (K) total protein, albumin, bilirubin, Aspartate Transaminase (AST), Alanine Transaminase (ALT) and Alkaline Phosphatase (ALP) in SCD as case group and apparently healthy person as control group.

Materials and Methods:

Study population: The study was conducted at Kassala Teaching Hospital, Kassala city, Eastern Sudan. This study was carried during December 2019 to January 2020. Hundred subjects were enrolled in this study were matched in age and gender, 50 patients with SCD, 22(44%) male, 28(56%) female, with age range from (5-14years) with their mean 8.92±2.724 years. and other 50 apparently healthy as control group, 22(44%) male, 28(56%) female, with age range from (5to 15years) with their mean (9.22±2.809years).

Inclusion criteria and Exclusion: patients with positive sickling test as included and any patients with renal and liver disease were excluded in the study.

Blood sampling and data collection: four ml blood sample were collected from each participants and cerfiguated at 3000 rpm for 5 minutes. The plasma urea, creatinine, total protein, albumin, Bilirubin, AST, ALT and ALP were estimated using Biosystem-350 (Semi automated chemistry analyzer), and plasma Na and K were estimated using Easylyte. The variable data of age and sex was collected using questionnaire and laboratory data records.

Data analysis: The data was analyzed using SPSS version (23), t-Test was used, and ($p \leq 0.05$) value was considered significant.

Ethical consideration: The study approval taken from Alzaim Alazhari review board and verbal constant taken from all participants before collection.

Quality control: Samples representing the normal and pathological level of plasma was used for assessment of the quality control. Result of the target values of the control sera was accepted.

Results:

The results of plasma Na, K, urea, creatinine, total protein, albumin, Bilirubin, AST, ALT and ALP were represented in table (1). The result showed that the plasma Na, K, urea, creatinine, total protein, albumin, Bilirubin, AST, ALT and ALP were significantly higher in case group as compared to control group. While, no was observed on plasma Na between groups. On the other hand, the correlation between age and plasma sodium, potassium, urea and creatinine were represented in table (2). The results demonstrated that the age of SCD had a strong positive correlation with plasma urea and creatinine respectively (r=.583, p=.000, r=.759, p=.000). While no correlation was observed between plasma Na and urea (r=-.335, p=.017). Moreover, there was a positive correlation between Plasma urea and plasma creatinine (r=.332, p=.018) .The strong association was observed between plasma Bilirubin and ALP activity (r= .563, P=.000). Otherwise, the results were showed the strong association between liver enzymes activity and SCD patients (r=.873, *381***,** 563, P= .000, .006, 000) table (3).

Table (1): Plasma biochemical parameters in the study population

Variables	Case(n=50)	Control(n=50)	P value
Sodium mmol/L	135.620±2.440 (130.00 -139.00)	134.800±2.020 (130.00-139.00)	0.070
Potassium mmol/L	4.356±.223 (4.00-4.80)	3.890±.349 (3.00-4.50)	0.000
Urea mg/dl	23.32±2.691 (18-29)	21.74±1.893 (18-26)	0.001
Creatinine mg/dl	.5160±.144 (.40-1.10)	.4680±.074 (.40-.70)	0.039
Total protein g/dl	7.716±.786 (6.00-9.00)	6.484±.856 (4.00-7.80)	0.000
Albumin g/dl	5.026±1.226 (2.80-7.50)	4.462±.857 (2.80-7.20)	0.009
Bilirubin mg/dl	2.848±1.237 (.50-7.00)	0.944±1.469 (.30-11.00)	0.000
AST IU/L	63.480±12.705 4(33.00-82.00)	36.080±5.173 (23.00-44.00)	0.000
ALT IU/L	43.420±15.440 (13.00-74.00)	30.180±10.421 (12.00-58.00)	0.000
ALP IU/L	148.400± 26.651 (96.00-246.00)	92.880±46.007 (9.00-246.00)	0.000

- t-test was used to calculate P value
- P value less than 0.05 considered significant
- Mean± Standard deviation
- Minimum – maximum between the brackets

Table (2): Correlation of age with sodium, potassium, urea and creatinine among case group.

		Age (Year)	Sodium mmol/L	Potassium mmol/L	Urea mg/dl	Creatinine mg/dl
Age (Year)	R value		-.189	.091	**.583****	**.759****
	P value		.189	.528	**.000**	**.000**
Sodium mmol/L	R value	-.189		.231	**-.335***	-.179
	P value	.189		.107	**.017**	.214
Potassium mmol/L	R value	.091	.231		-.078	-.035
	P value	.528	.107		.590	.812
Urea mg/dl	R value	**.583****	**-.335***	-.078		**.332***
	P value	**.000**	**.017**	.590		**.018**
Creatinine mg/dl	R value	**.759****	-.179	-.035	**.332***	
	P value	**.000**	.214	.812	**.018**	

Table (3): Correlation of age with total protein, albumin, bilirubin, AST, ALT and ALP among case group.

		Age (Year)	Total protein	Albumin	Bilirubin	AST	ALT	ALP
Age (Year)	R value		.143	.023	-.127	-.071	-.005	-.194
	P value		.323	.876	.381	.625	.975	.177
Total protein	R value	.143		.165	.105	.053	.011	.001
	P value	.323		.253	.467	.717	.938	.992
Albumin	R value	.023	.165		.173	.200	.243	-.147
	P value	.876	.253		.229	.163	.089	.308
Bilirubin	R value	-.127	.105	.173		.209	.106	**.563****
	P value	.381	.467	.229		.145	.462	**.000**
AST	R value	-.071	.053	.200	.209		**.873****	**.381****
	P value	.625	.717	.163	.145		**.000**	**.006**
ALT	R value	-.005	.011	.243	.106	**.873****		.192
	P value	.975	.938	.089	.462	**.000**		.182
ALP	R value	-.194	.001	-.147	**.563****	**.381****	.192	
	P value	.177	.992	.308	**.000**	**.006**	.182	

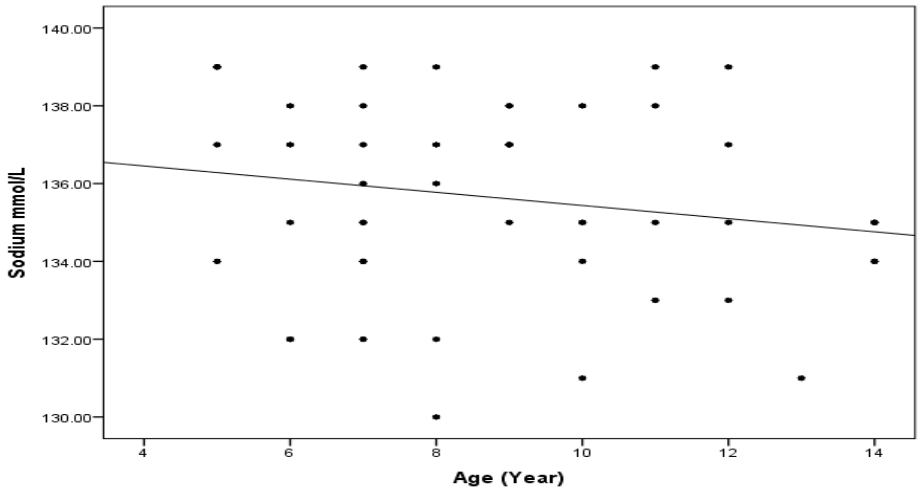

Figure (1): correlation of age and plasma sodium in case group

R= value -.189, P =value .189

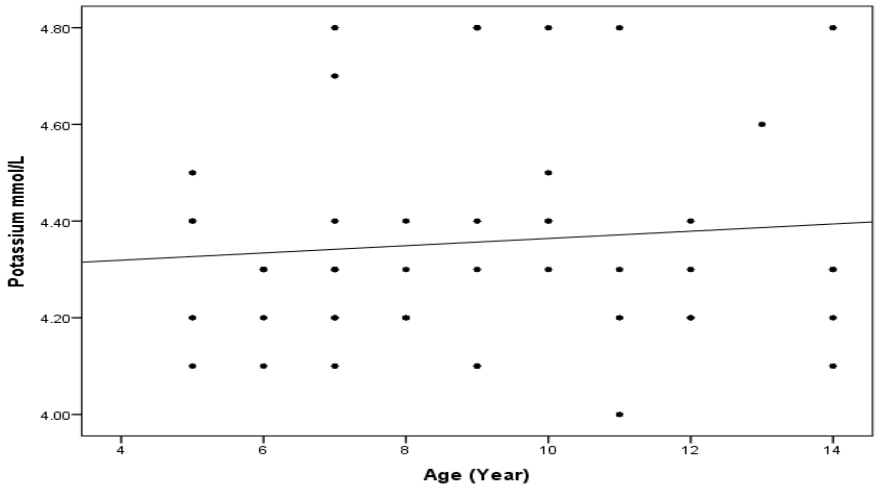

Figure (2): correlation of age and potassium in case group

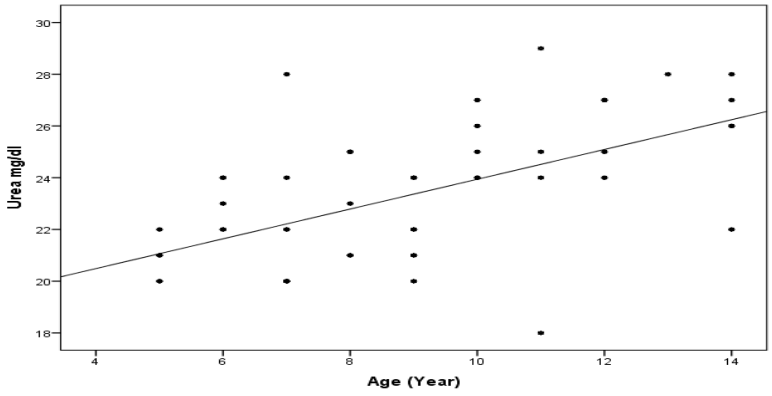

Figure (3): correlation of age and urea in case group

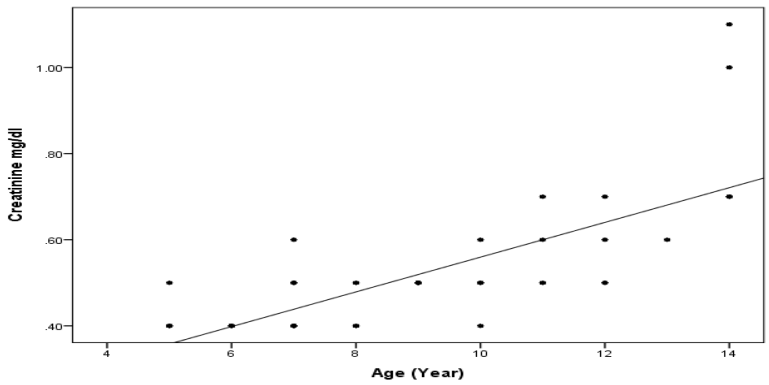

Figure (4): correlation of age and creatinine in case group

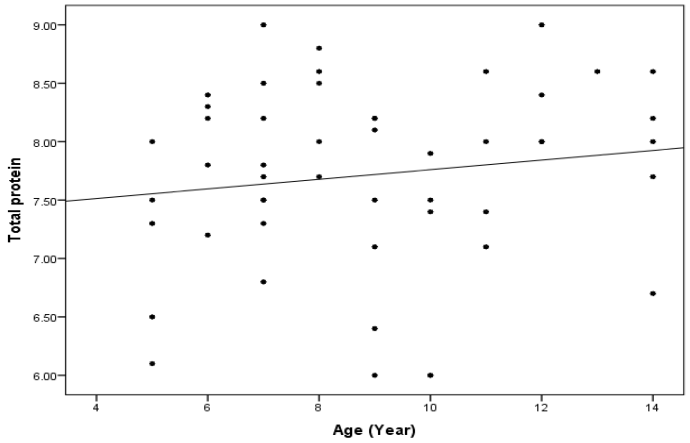

Figure (5): Correlation of age and total protein among case group

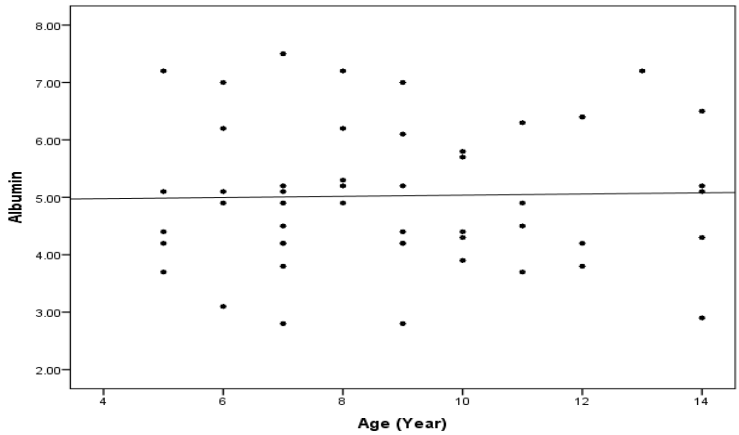

Figure (6): correlation of age and albumin among case group

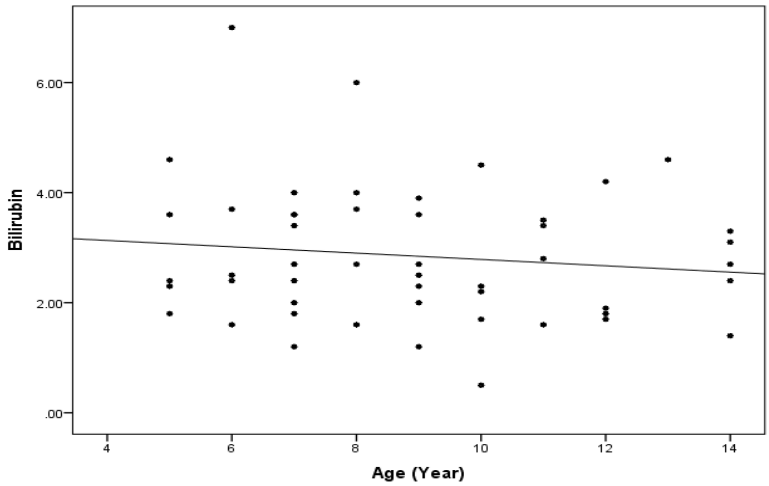

Figure (7): correlation of age and bilirubin among case group

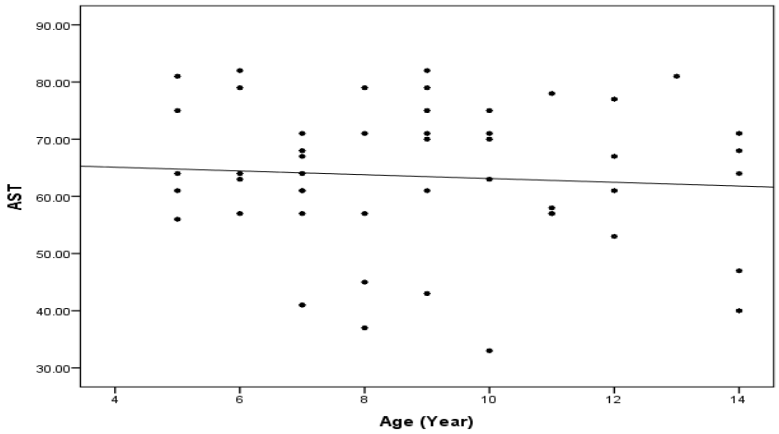

Figure (8): correlation of age and AST among case group

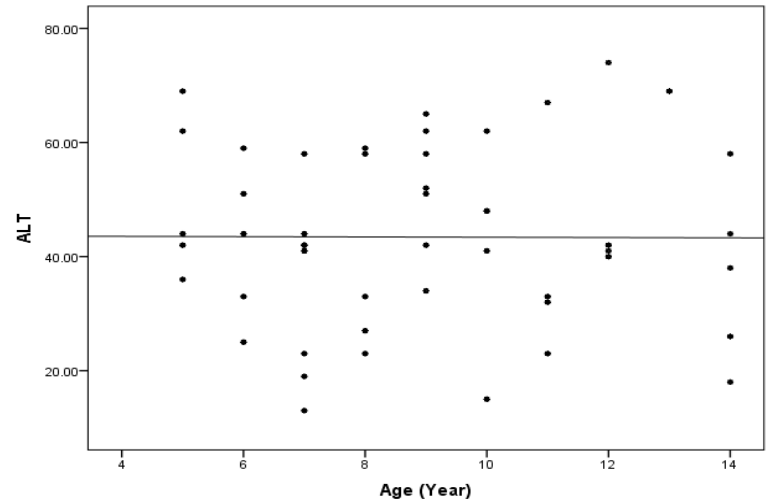

Figure (9): correlation of age and ALT among case group

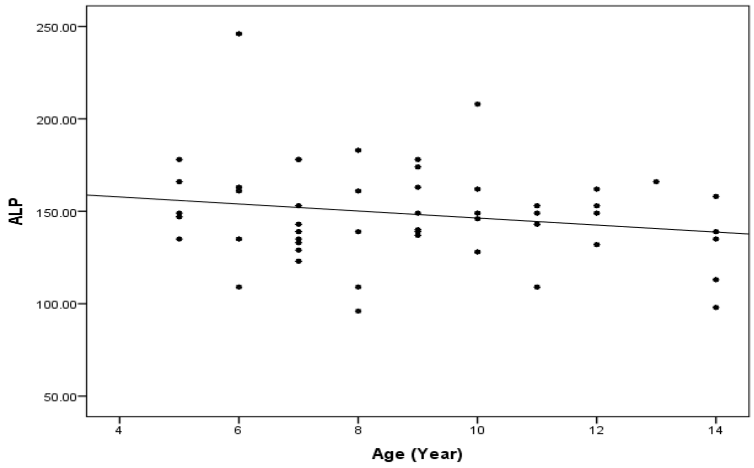

Figure (10): correlation of age and ALP among case group

Discussion:

The plasma Na was insignificance difference in SCD compared to control group. The plasma K, urea and creatinine were significantly increase compared to control group. Also the plasma total protein, albumin, Bilirubin, AST, ALT and ALP were significantly increase in case group compared to control group. The age were strong association into plasma urea and plasma creatinine . The negative correlation between plasma Na and plasma urea There were positive correlation between plasma urea and creatinine Their strong association between plasma bilirubin and ALP activity, and also their strongly association between liver enzymes activity among SCD patients .Our study supported by Pandey *et al*., [(11)], reported that electrolytes, hepatic enzymes, alkaline phosphatase were elevated and statistically significant. A rise in bilirubin is not unexpected since there is a higher than normal rate of breakdown of red blood cells in sickle cell disease patients. Also, sickle cell disease related infarcts, occurring in a variety of organs including the liver, have been reported [(12)]. Miroinfarcts in the liver could exacerbate the rise in serum Bilirubin and would account for the much higher level in crises. Similarly, the low level of haemoglobin, which is further reduced in crises as observed in this study, is attributed to the continuous haemolysis in sickle cell disease. This is similar to the results in Nigerian sickle cell patients [(13)]. In this study there no correlation between age and liver enzymes, the result disagree with Isichei's study [(14)] which reported that there was statistically significant correlation between age and liver enzymes , and also our results disagree with Mahera and Kolita's study [(15,16)], which reported that. There was no correlation between gender and AST level. Our results of the plasma AST and ALT were significantly increased in SCD compared to control group supported by Nsiah *et al* [(17)]. In our results the liver enzymes and bilirubin were significantly increased in SCD, Supported by other study Akuyam, *et al*.[(18)]. Our findings showed that there was no correlation between age and liver enzymes ,disagree with study Akuyam, *et al*.[(18)] who reported that, there was asignificant negative correlation between age and each of serum TB, ALT,AST, ALP,and AST/ALT, and significant positive correlation between age and each of serum ALP and bilirubin among these patients. Our finding of plasma Na, K, urea and creatinine agree with study irhomwanbor *et al* [(19)].

Conclusion:

The study concluded that, significance increased in plasma K, urea creatinine, plasma total protein, and albumin, Bilirubin, AST, ALT and ALP. Their association between age and plasma urea, creatinine, and the negative correlation between plasma Na and plasma urea and also positive correlation between plasma urea and creatinine. There were positive correlation between plasma urea and creatinine. Their strong association between plasma bilirubin and ALP activity and also their strongly association between liver enzymes activity among SCD patients. The results of this study revealed that physicians and caregivers need to be more attentive to liver function in children with sickle cell disease.

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